

## Copepods from ground waters of Western Australia, V. *Phyllopodopsyllus wellsii* sp. nov. (Crustacea: Copepoda: Harpacticoida) with a key to world species

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**Abstract** – *Phyllopodopsyllus wellsii* sp. nov. is described from anchialine ground waters of the Cape Range karst area in north-western Australia and has clear stygomorphies, being colourless and lacking the nauplius eye. The genus is for the first time recorded from Australia, as well as for the first time from outside strictly marine habitats. A key to all the species of the genus *Phyllopodopsyllus* T. Scott, 1906 is presented.

### INTRODUCTION

Arid north-western Australia is proving to contain a diverse stygofauna inhabiting both ancient freshwater systems (Bradbury and Williams, 1997; Poore and Humphreys, 1999a; Watts and Humphreys, in press) as well as anchialine waters (Humphreys, in press). Recently, a number of stygal cyclopoid copepods have been described from the ground waters of Western Australia in both near-coastal (Pesce *et al.*, 1996a, 1996b; Pesce and De Laurentiis, 1996) and ancient continental regions (De Laurentiis *et al.*, 1999). The present paper concerns an harpacticoid copepod from anchialine ground waters of north-western Australia, belonging to a genus previously recorded only in strictly marine habitats.

According to Bodin (1997), the tetragonicipitid genus *Phyllopodopsyllus* T. Scott, 1906 is, one of the most speciose marine harpacticoid genera, together with *Halectinosoma* Lang, 1944 and *Stenhelia* Boeck, 1865, and marine harpacticoid genus with the largest number of new described species in the last fifty years. Lang (1948) initially divided the genus *Phyllopodopsyllus* into two genera (*Phyllopodopsyllus* and *Paraphyllopodopsyllus*), based upon the shape of the second segment of the antennula and setation of second and third swimming legs in females. Many authors followed this revision, and Vervoort (1964) provided an useful key to species of the genus *Phyllopodopsyllus*, although not for *Paraphyllopodopsyllus*. After several new species were described possessing intermediate characteristics, Lang (1965) synonymized *Paraphyllopodopsyllus* with *Phyllopodopsyllus* and compiled an excellent key to 21 species then recognized. He subdivided the genus into three morphological groups based on the second antennular segment (i.e. presence or

absence, and dimensions of an unguiform projection). Coull (1973) presented a very detailed survey of the genus *Phyllopodopsyllus*, and compiled an instructive table listing the most salient morphological characteristics. His key included 33 species and subspecies. Finally Kunz (1984) reviewed the genus, and tabulated setal formulae of the second, third, and fourth swimming legs in female, as well as the antennulae segmentation and shape. He subdivided the genus into nine species groups, based on these characteristics: 1 – *bradyi*, 2 – *furciger*, 3 – *aegypticus*, 4 – *borutzkyi*, 5 – *pauli*, 6 – *opistoceratus*, 7 – *mossmanni*, 8 – *xenus*, and 9 – *longipalpatum* group. Fiers (1995) doubted the “naturalness of these groups”, but proposed nothing new, placing his new species (*P. yucatanensis*) within one of Kunz’s groups. Subsequent to the last review of the genus (Kunz, 1984) 13 new species and subspecies have been described: *P. alatus* Fiers, 1986; *P. crenulatus* Wells and Rao, 1987; *P. gracilipes* Wells and Rao, 1987; *P. stigmatosus* Wells and Rao, 1987; *P. tenuis* Wells and Rao, 1987; *P. galapagoensis* Mielke, 1989; *P. kunzi* Mielke, 1989; *P. ancylus* Mielke, 1992; *P. carinatus* Mielke, 1992; *P. mossmanni chiloensis* Mielke, 1992; *P. hartmannorum* Kunz, 1995; *P. pallaresae* Kunz, 1995; and *P. yucatanensis* Fiers, 1995. In addition Wells and Rao (1987) described the male of *P. aegypticus* Nicholls, 1944 and Kunz (1995) described the male of *P. xenus* (Kunz, 1951). Kunz (1984) however did not mention three species already described: *P. laticauda* Por, 1964; *P. medius* Por, 1964; and *P. bahamensis* Geddes, 1968. Even though some of the species above are synonyms, the number of species in the genus *Phyllopodopsyllus* has increased considerably, and a key for their identification is therefore included in this paper. During an

investigation of the copepod fauna in Western Australia a new species of the genus *Phyllopodopsyllus* was identified. This new species is herein described as *P. wellsi* sp. nov.

### HABITAT AND ASSOCIATED FAUNA

The copepods were sampled from ground water in karst terrain, accessed by temporary bores drilled for a seismic survey. The bores were located on a wave-cut limestone terrace overlain by Quaternary deposits on the north-western tip of the Cape Range peninsula, Western Australia. Bore A5 lies one kilometre south-east of Babjarrimannos at an altitude of a 12 m ASL and ca. 1000 m from the seashore; the water table approximates sea level and had a salinity of 24.7 g/dm<sup>3</sup>. Bore A7 is within one kilometre of Vlaming Head at an altitude of a 10 ASL and ca. 350 m from the seashore; the water is about sea level and had a salinity of 25.7 g/dm<sup>3</sup>. Ground water on the eastern side of the peninsula, where it has been recorded, typically tracks the marine tides but exhibits a temporal and amplitude lag (Humphreys *et al.*, 1999). The waters are typically anchialine (Stock *et al.*, 1986; Sket, 1996; Humphreys, 1999b) and exhibit a marked physico-chemical stratification (Humphreys, 1999b). Fauna sampled within the same boreholes as *Phyllopodopsyllus wellsi* sp. nov. were all stygal species and included the blind gudgeon *Milyeringa veritas* Whitley (Pisces: Eleotridae), calanoid copepods and meltid amphipods. These form part of a more widespread and diverse stygofauna inhabiting both fresh and anchialine waters of the Cape Range peninsula, with elements being found on Barrow Island 170 km to the north-east (Humphreys, 1999b; in press; Humphreys *et al.*, 1999). The following cyclopoid copepods are known from the area: *Apocyclops dengizicus* (Lepechkin), *Halicyclops longifurcatus* Pesce, De Laurentiis and Humphreys, *Metacyclops mortoni* Pesce, De Laurentiis and Humphreys, *Microcyclops varicans* G.O. Sars, and *Diacyclops humphreysi* Pesce and De Laurentiis. In addition, the wider anchialine fauna contains numerous widely disjunct taxa, many of which occupy a "Tethyan" track, such as *Lasinectes* (Remipedia), *Halosbaena* (Thermosbaenacea), *Haptolana* (Isopoda), *Liagoceradocus* (Amphipoda), *Danielopolina* (Ostracoda), as well as misophrioid and calanoid copepods (Yager and Humphreys, 1996; Poore and Humphreys, 1992; Bruce and Humphreys, 1993; Bradbury and Williams, 1996; Danielopol *et al.*, in press).

### MATERIAL AND METHODS

The sites were sampled using baited traps and haul-nets from 'uphole' bores drilled to locate recording equipment for a seismic survey.

Permanent mounts were made in commercial polyvinyl-lactophenol and in Faure's medium. Dissected specimens were drawn at magnification of 630x and 1000x with drawing tube mounted on a Leica DMLS microscope, with C-plan achromatic objectives. All material is deposited in the Western Australian Museum (WAM) and BES denotes field numbers from the Invertebrate Biogeography and Ecology group. Abbreviations used in the key to species are: Fu – furcal rami; A1 – antennula; P1–P4 – first to fourth swimming leg; P5 – fifth leg; Enp – endopodite; Exp – exopodite; Enp2P3 – second endopodite segment of the third swimming leg.

### SYSTEMATICS

Family Tetragonicipitidae Lang, 1944

Genus *Phyllopodopsyllus* T. Scott, 1906

*Phyllopodopsyllus wellsi* sp. nov.

Figures 1–19

#### Material Examined

##### Holotype

♀ (WAM C24456), Cape Range, AB7, Western Australia, Australia, 21°49'S, 114°06'E, 11 November 1995, leg. R.D. Brooks (BES 4676.1).

##### Allotype

♂ (WAM C244457), Cape Range, AB7, Western Australia, Australia, 21°49'S, 114°06'E, 11 November 1995, leg. R.D. Brooks (BES 4676.1).

##### Paratypes

Australia: Western Australia: 14 ♂, 11 ♀ (9 ovigerous) (WAM 24458 – C24465, on slides, C24466 in alcohol) Cape Range, AB7, 21°49'S, 114°06'E, 11 November 1995, leg. R.D. Brooks (BES 4676.2).

##### Other material

Australia: Western Australia: 3 ♂, 5 ♀ (4 ovigerous) (WAM C24467, in alcohol), Cape Range, AB7, 21°49'S, 114°06'E, 5 November 1995, leg. R.D. Brooks (BES 4673).

1 ♀ (WAM C24468, on slide), Cape Range, AB5, 21°50'S, 114°05'E, 4 November 1995, leg. R.D. Brooks (BES 4666).

#### Description

##### Female (holotype)

Habitus elongated, cylindrical. Body colourless, and nauplius eye absent. Cuticle densely furnished with minute pits, especially on furcal rami and antennula (Figures 1 and 2). Prosoma comprising cephalothorax, incorporating first pedigerous



Figures 1-4 *Phyllopodopsyllus wellsi* sp. nov., holotype (female): 1 - antennula and rostrum; 2 - abdomen, dorsal view; 3 - maxilliped; 4 - mandibula. Scales = 0.1 mm.

somite, and 3 free pedigerous somites. Surface of dorsal shield covering cephalothorax with many sensillae, as well as tergites of 3 free pedigerous somites. Hind margins of somites smooth. Rostrum almost quadrate, with single pair of sensillae, and with row of very fine spinules on distal margin (Figure 1). Urosome comprising fifth pedigerous somite, genital double-somite (representing fused genital and first abdominal somite), and 3 free abdominal somites. Genital double-somite almost as long as wide (Figures 6 and 9). Subdivision line visible dorsally, furnished with 6 sensillae, while laterally and ventrally marked by rigid internal sclerotized ridge. One ventral and one dorsal pair of sensillae presented posteriorly on genital double-somite, as well as on first free abdominal somite (Figure 2); second free abdominal somite lacking sensillae. Their hind margins smooth, too. Anal somite (last abdominal somite) ornamented only with pair of sensillae dorsally. Anal operculum convex, not reaching beyond limit of anal somite, with many marginal spines (Figure 2).

Furcal rami divergent, about 3.8 times longer than wide, with complete armature (2 lateral, 1 dorsal and 3 apical setae), and without dorsal chitinous ridge. Their inner margins with row of fine hairs, especially long in distal part (Figure 2). Dorsal seta attached at distal sixth of furcal length, well developed, while lateral setae very short. Outer apical seta somewhat moved to ventral side, as long as inner apical seta. Middle apical seta extraordinary strong, slightly curved at end, and long as other two apical setae.

Antennula 8-segmented, with 1 slender aesthetasc on apical segment, 1 very long aesthetasc on fourth segment (more than twice longer than 4 distal segments taken together), and with setal formula as follows: 1.8.5.2.1.2.4.7 (Figure 1). All setae smooth. Second segment with very large, posteriorly directed, unguiform process, and lacking anterior process. First segment about 3 times as long as wide.

Antenna with almost completely reduced coxa, 1-segmented basis and exopodite, and 2-segmented endopodite (Figure 12). Inner margin of basis furnished with long spinules. Exopodite with 3 elements, of which outer one basally fused with segment. First endopodite segment only with few small spinules on outer margin. Second endopodite segment with 2 lateral spines and 6 apical setae, as well as with many spinules along outer margin (Figure 12).

Mandibula with cutting edge of coxa with row of teeth of different thickness and with single lateral seta (Figure 4). Basis large, bearing 3 setae on inner margin (1 smooth and 2 plumose), and furnished with 2 transverse rows of long slender spinules. Endopodite twice longer than exopodite, armed with 2 lateral and 4 apical smooth setae. Exopodite

armed with 1 lateral and 2 apical (1 smooth and 1 plumose) setae (Figure 4). Both rami 1-segmented.

Maxillula with 13 setae on precoxa, 5 setae on coxa, 8 on basis, 4 on endopodite and 3 setae on exopodite.

Maxilla with 10 seta on syncoxa (2 setae on each of proximal 2 endites; 3 setae on each of distal 2 endites), 4 on basis and 6 setae altogether on 2-segmented endopodite.

Maxilliped with unornamented syncoxa, which armed with 3 plumose setae (Figure 3). Basis with 1 seta and row of long spinules on inner margin. Endopodite 1-segmented, armed with strong recurved apical claw and slender smooth subapical seta (Figure 3).

All swimming legs with 3-segmented exopodites and 2-segmented endopodites (Figures 5, 7, 8 and 11). Spine and setal formula on exopodites and endopodites from first to fourth swimming legs (legend: inner / outer spine or seta; inner / terminal / outer):

Segments	Exopodite			Endopodite	
	1	2	3	1	2
First leg	0/1	0/1	0/2/2	1/0	0/2/0
Second leg	1/1	0/1	1/2/2	0/0	0/3/0
Third leg	1/1	0/1	1/2/2	1/0	0/2/0
Fourth leg	1/1	0/1	3/2/2	1/0	0/2/0

Couplers (intercoxal sclerites) of all swimming legs with concave distal margin and without surface ornamentation. Coxa of third and fourth swimming legs unornamented, while coxa of second leg bearing row of hairs on inner-distal corner and coxa of first leg ornamented with row of spinules on outer margin. Basis of first and second swimming legs with row of hairs on inner margin, while those of third and fourth legs without ornamentation. Basis of first swimming leg bearing 1 strong spine on inner margin (attached at first third of segment's length). All swimming legs with smooth epipodite setae, on outer margin of basis. Apical and outer elements on distal exopodite segment of fourth swimming leg reduced, setiform (Figure 5).

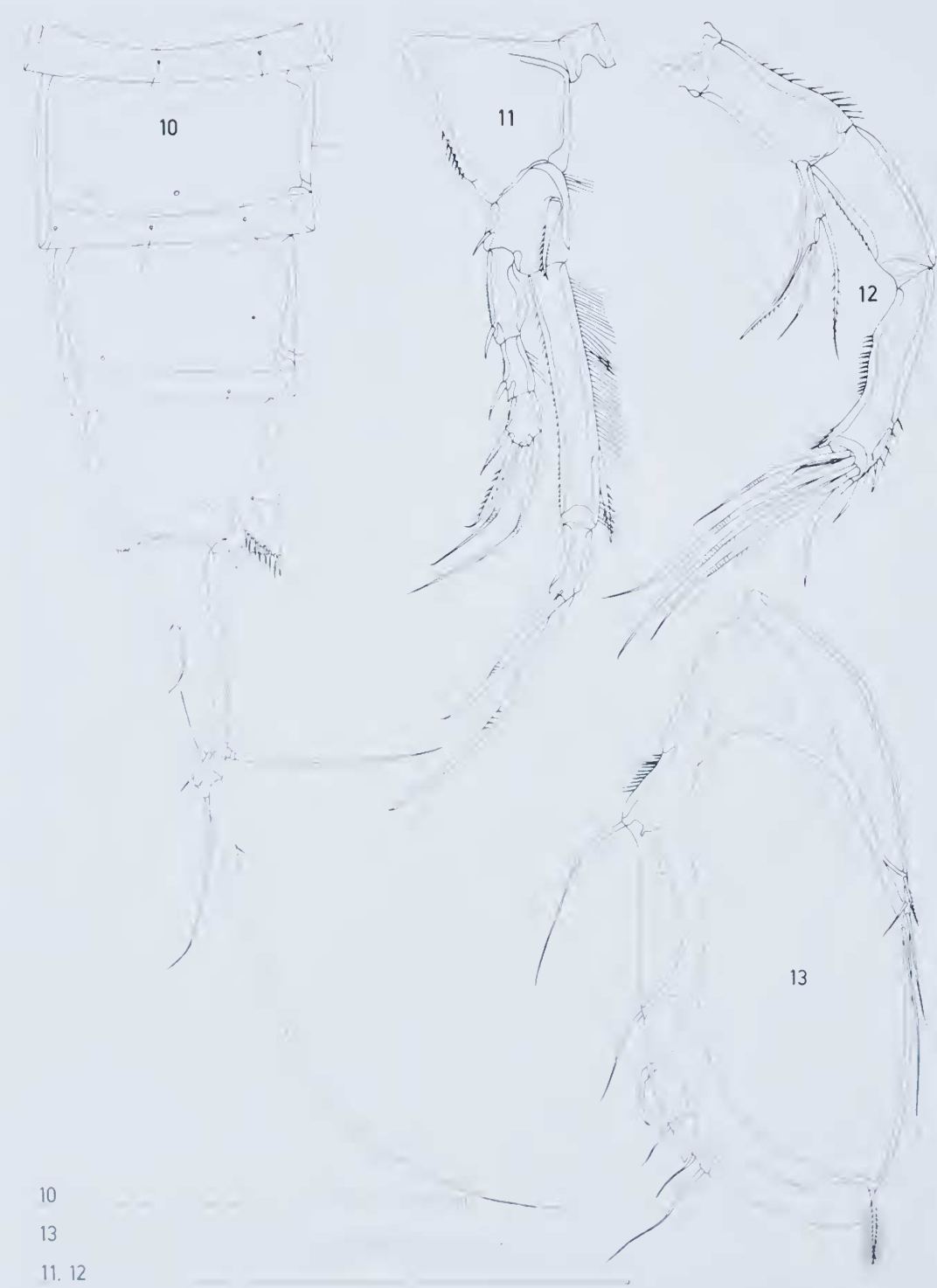
Fifth leg typically foliaceous, with completely fused basoendopodite and exopodite, but with clear chitinous suture marking original separation (Figure 13). Epipodite seta well developed, and between it and proximal margin of basis 1 row of slender spinules exists. Former basoendopodite armed with 4 slender setae. Former exopodite segment armed with 6 setae, of which only innermost one plumose. Fifth seta on that segment, from inner margin, characteristically curved (Figure 13). Fifth leg cavity without eggs.

Sixth leg fused with genital double-somite, bearing 2 smooth setae, of which outer one about 1.8 times longer than inner (Figure 6). Genital field present in distal half of first genital somite, having short copulatory ductus connecting wide copulatory pore and small paired seminal

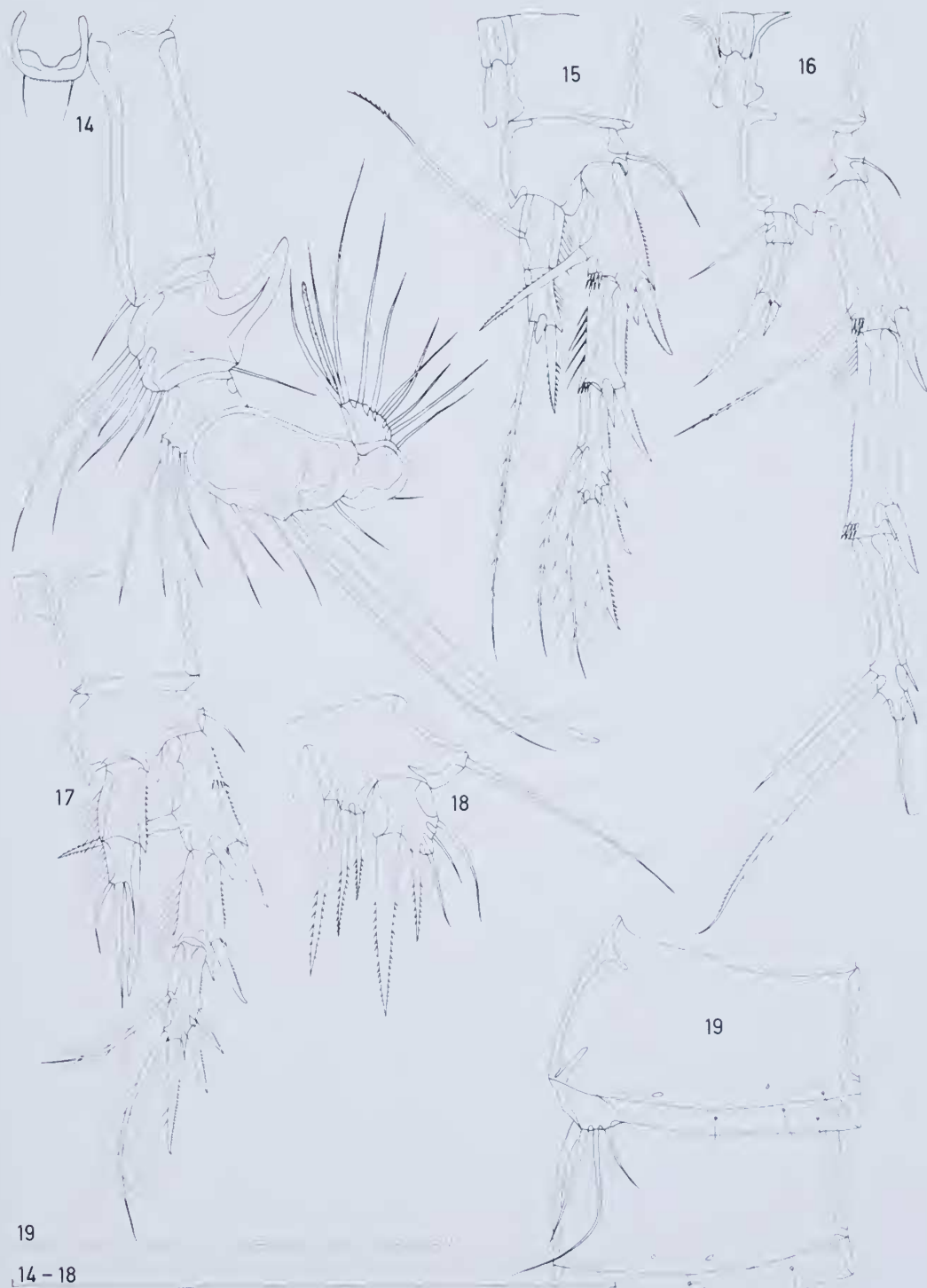




Figures 5-9 *Phyllopodopsyllus wellsi* sp. nov., holotype (female): 5 - fourth swimming leg; 6 - genital double-somite, ventral view; 7 - second swimming leg; 8 - third swimming leg; 9 - genital double-somite, dorsal view. Scales = 0.1 mm.



Figures 10-13 *Phyllopodopsyllus wellsi* sp. nov.; 10, allotype (male); 11-13, holotype (female): 10 - abdomen, lateral view, 11 - first swimming leg; 12 - antenna; 13 - fifth leg. Scales = 0.1 mm.



Figures 14–19 *Phyllopodopsyllus wellsi* sp. nov., allotype (male): 14 – antennula and rostrum; 15 – third swimming leg; 16 – fourth swimming leg; 17 – second swimming leg; 18 – fifth leg; 19 – genital somite with sixth leg, lateral view. Scales = 0.1 mm.

receptacles. Small, tongue-like, spermatophore attached to genital pore (Figure 6).

#### *Male (allotype)*

Body similar to female in general appearance, slightly more slender. Urosome comprising fifth pedigerous somite, genital somite, and 4 free abdominal somites. Genital somite about 1.5 times broader than long. All somites with smooth hind margins, and with different number of sensillae.

Furcal rami similar to female, but outer and middle apical setae much longer (Figure 10). Outer apical seta more than twice longer than inner apical one, while middle apical seta almost as long as abdomen.

Antennula strongly geniculate, with almost completely fused fourth and fifth segments (only 1 cuticular suture remained between them), and with completely fused sixth and seventh segments (Figure 14). First and second, as well as ultimate, segments very similar to female.

Antenna, mandibula, maxillula, maxilla, maxilliped, first swimming leg, exopodite of second (Figure 17) and third swimming legs (Figure 15) also very similar to those of female.

Outermost apical seta on distal endopodite segment of second swimming leg very strong and basally fused with segment (Figure 17). Innermost apical seta on that segment short and smooth. Endopodite of fourth swimming leg similar to female, except for inner apical seta on distal segment being much stronger, curved, and smooth (Figure 16). Distal exopodite segment of fourth swimming leg with only 5 appendages (2 inner, 1 apical and 2 outer).

Basoendopodite of fifth leg with 3 strong, plumose and spiniform endopodite setae (innermost seta longest), and with very long and smooth epipodite seta (Figure 18). Exopodite subquadrangular, somewhat longer than broad, and armed with 5 elements (of which innermost spine extraordinary strong and longest). Outer-distal corner of exopodite distinctly produced, but without sharp extension.

Sixth leg consisting of small triangular chitinous plate bearing 3 setae (Figure 19). Middle seta about 1.6 times longer than inner one, and 2.8 times longer than outermost seta.

#### Variability

Thirty-six specimens (18 males and 18 females) of *Phyllopodopsyllus wellsi* sp. nov., from 3 different localities, were found and examined. Eleven specimens were completely dissected and mounted on slides. Body length, measured from the tip of rostrum to the posterior margin of furcal rami, ranges from 0.41 mm to 0.523 mm (0.455 mm average) in males, and from 0.47 mm to 0.592 mm (0.527 mm average) in females. In both sexes the

distal endopodite segment of the third swimming leg can have either 2 or 3 apical setae. In specimens with 3 setae, the pattern is very similar to that of the distal endopodite segment of the second swimming leg in females (Figure 7). Sometimes left and right third legs of the same specimen can bear different number of setae on that segment. No such variability has been noted in the number of setae and spines of the other swimming legs. The exopodite of the male fifth leg with or without very small sharp extension on outer-distal corner (between second and third setae, from outer side). Moreover, sometimes one leg displays such extension, while opposite leg does not in same animal. The outer seta on the female sixth leg can be more or less plumose. Anal somite in female usually with 1 row of very small, equal, spinules at base of furcal rami ventrally, but sometimes with a few larger spinules in the middle of that row. Holotype female is without eggs, but ovigerous females always with only two large eggs in the fifth leg cavity. The eggs are with very thin chorion.

#### Etymology

The species is named in honour of Dr J.B.J. Wells, Victoria University of Wellington, New Zealand.

#### DISCUSSION

*Phyllopodopsyllus wellsi* sp. nov. differs from all other species in the genus by its characteristic furcal rami shape in the female, and especially by the middle apical seta, which is very short, stout, and slightly and characteristically curved distally. Basoendopodite of the fifth leg in male with innermost seta the longest is also a rare characteristic in the genus *Phyllopodopsyllus*. Only three other species possess a similar basoendopodite: *P. xenus* (Kunz, 1951); *P. paraxenus* Coull, 1970; and *P. hermani* Coull, 1969. *P. xenus* has indeed only two setae on that segment (Kunz, 1995), and differs from the new species also by many other characters such as antennula segmentation, swimming legs setation, furcal rami shape, etc. *P. paraxenus* has 9-segmented antennula without unguiform process on second segment, possesses different setation of swimming legs, and a different furcal rami shape (Coull, 1970). Also, the middle seta on fifth leg basoendopodite in male of that species is extremely short. *P. hermani* differs from the new species by many characteristics (Coull, 1969). Regarding the shape of the fourth swimming leg endopodite in female (1 seta on basal and 2 setae on distal segment) *P. wellsi* is similar with the four following species: *P. minutus* Lang, 1948; *P. bahamensis* Geddes, 1968; *P. paraxenus* Coull, 1970; and *P. tenuis* Wells and Rao, 1987. They all differ from the new species by their swimming leg setation and shape of the furcal rami, whereas *P. bahamensis* and *P. paraxenus* also differ by the



antennula segmentation (Lang, 1948; Geddes, 1968; Coull, 1970; Wells and Rao, 1987). *P. wellsi* does not fit well within any of nine species group created by Kunz (1984), which maybe confirms suspicions about its naturalness expressed by Fiers (1995), but the philogenetical grouping of the species is outside the scope of this paper. Because we do not want to create a new group for this species, we provide a key to all species and subspecies in the genus *Phyllopodopsyllus*. In that key have used mainly female morphological characteristics, unless stated otherwise.

Key to species and subspecies of the genus  
*Phyllopodopsyllus*

1. EnpP4 1-segmented .....	2
EnpP4 2-segmented .....	3
2. Enp1P2 and Enp1P3 with inner seta .....	
..... <i>P. geddesi</i> Kunz, 1984	
Enp1P2 and Enp1P3 unarmed .....	
..... <i>P. opisthoceratus</i> Geddes, 1968	
3. Enp1P4 unarmed .....	4
Enp1P4 with inner seta .....	8
4. A1 9-segmented ..... <i>P. xenus</i> (Kunz, 1951)	
A1 8-segmented .....	5
5. ExpP1 2-segmented .....	
..... <i>P. biarticulatus</i> (Wells, 1967)	
ExpP1 3-segmented .....	6
6. Enp2P4 with 3 setae .....	
..... <i>P. longipalpalatus hawaiiensis</i> Kunz, 1984	
Enp2P4 with 2 setae .....	7
7. Fu with dorso-lateral cuticular process .....	
.... <i>P. longipalpalatus madagascarensis</i> Kunz, 1984	
Fu without that process .....	
<i>P. longipalpalatus longipalpalatus</i> (Chappuis, 1954)	
8. Enp2P4 with only 1 seta .....	
..... <i>P. hermani</i> Coull, 1969	
Enp2P4 with more than 1 seta .....	9
9. Enp2P4 with 2 setae .....	10
Enp2P4 with 3 setae .....	14
10. A1 9-segmented .....	11
A1 8-segmented .....	12
11. A1 with unguiform process .....	
..... <i>P. bahamensis</i> Geddes, 1968	
A1 without unguiform process .....	
..... <i>P. paraxenus</i> Coull, 1970	
12. Enp1P3 without seta ..... <i>P. minutus</i> Lang, 1948	
Enp1P3 with inner seta .....	13
13. Exp3P2 and Exp3P3 with 4 setae/spines .....	
..... <i>P. tenuis</i> Wells and Rao, 1985	

Exp3P2 and Exp3P3 with 5 setae/spines .....	
..... <i>P. wellsi</i> n.sp.	
14. Enp1P3 without seta .....	15
Enp1P3 with inner seta .....	21
15. Exp2P4 without inner seta .....	
..... <i>P. medius</i> Por, 1964	
Exp2P4 with inner seta .....	16
16. Enp2P2 and Enp2P3 with 2 setae .....	
..... <i>P. hartmannorum</i> Kunz, 1995	
Enp2P2 and Enp2P3 with 3 setae .....	17
17. Enp1P1 without inner seta .....	
..... <i>P. punctatus</i> Kitazima, 1981	
Enp1P1 with inner seta .....	18
18. Exp3P2 with 4 setae/spines .....	
..... <i>P. laticauda</i> Por, 1964	
Exp3P2 with 5 setae/spines .....	19
19. A1 8-segmented ..... <i>P. bernudae</i> Lang, 1948	
A1 9-segmented .....	20
20. Enp1P1 almost as long as ExpP1 .....	
..... <i>P. angolensis</i> Kunz, 1984	
Enp1P1 about 1.5 times longer than ExpP1 .....	
..... <i>P. aegypticus</i> Nicholls, 1944	
21. Enp1P2 without seta .....	22
Enp1P2 with inner seta .....	32
22. Exp2P4 without inner seta .....	23
Exp2P4 with inner seta .....	24
23. A1 9-segmented ..... <i>P. borutzkyi</i> Lang, 1965	
A1 8-segmented ..... <i>P. simplex</i> Kitazima, 1981	
24. Exp3P3 with 5 setae/spines .....	
..... <i>P. langi</i> Kunz, 1975	
Exp3P3 with 6 setae/spines .....	25
25. A1 9-segmented .....	26
A1 8-segmented .....	28
26. Fu about 7 times as long as wide .....	
..... <i>P. longicaudatus</i> A. Scott, 1909	
Fu less than 2.5 times as long as wide .....	27
27. Fu with large proximal inner bulge .....	
..... <i>P. bradyi</i> (T. Scott, 1892)	
Fu without proximal inner bulge .....	
..... <i>P. pallaresae</i> Kunz, 1995	
28. A1 with additional sharp process on the anterior distal corner of second segment ....	29
A1 without additional sharp process (just one unguiform, posteriorly directed) .....	30
29. Dorsal seta attached almost at end of Fu .....	
..... <i>P. parafurciger parafurciger</i> Geddes, 1968	
Dorsal seta attached at 2/3 of furcal length .....	
..... <i>P. parafurciger caroliensis</i> Coull, 1971	

30. Fu with well developed dorsal chitinous ridge .  
..... *P. furciger* Sars, 1907  
Fu without dorsal ridge ..... 31

31. Fu more than 6 times longer than wide .....  
..... *P. curtus* Marcus, 1976  
Fu about 4 times longer than wide .....  
..... *P. stigmatosus* Wells and Rao, 1987

32. Exp2P4 without inner seta ..... 33  
Exp2P4 with inner seta ..... 43

33. A1 8-segmented ..... 34  
A1 9-segmented ..... 35

34. Exp3P3 with 4 setae ..... *P. danielae* Bodin, 1964  
Exp3P3 with only 3 setae . *P. kunzi* Mielke, 1989

35. A1 with strong, sharp, unguiform process on  
second segment ..... 36  
A1 without or with small blunt process ..... 37

36. Exp3P4 with 6 setae and spines .....  
..... *P. paraborutzkyi* Kunz, 1975  
Exp3P4 with 7 setae and spines .....  
..... *P. carinatus* Mielke, 1992

37. A1 with small blunt process on second segment  
..... 38  
A1 without any process ..... 39

38. Exp3P4 with 7 setae/spines, Fu 1.5 times longer  
than wide ..... *P. hibernicus* (Roe, 1955)  
Exp3P4 with 6 setae/spines. Fu 3 times longer  
than wide ..... *P. hardingi* (Roe, 1955)

39. Exp3P4 with 6 setae/spines .....  
..... *P. paramosmani* (Lang, 1934)  
Exp3P4 with 7 setae/spines ..... 40

40. Fu about 3.5 times as long as broad .....  
..... *P. berrieri* Monard, 1936  
Fu about 1.5 times as long as broad ..... 41

41. Middle apical seta on Fu not broadened basally  
..... *P. laspalmensis* Marinov, 1973  
Middle apical seta on Fu broadened basally ....  
..... 42

42. ExpP5 with 5 setae in male .....  
..... *P. mossmani* T. Scott, 1912  
ExpP5 with 4 setae in male .....  
..... *P. mossmani chiloensis* Mielke, 1992

43. A1 8-segmented ..... 44  
A1 9-segmented ..... 47

44. Exp3P2 and Exp3P3 with 4 setae/spines ..... 45  
Exp3P2 with 5, while Exp3P3 with 6 setae/  
spines ..... 46

45. Middle apical seta on Fu minute compared to  
furcal length ..... *P. pauli* Crisafi, 1960

Middle apical seta on Fu long and stout .....  
..... *P. ancylus* Mielke, 1992

46. Exp3P4 with 6 setae/spines .....  
..... *P. chavez* Coull, 1970  
Exp3P4 with 7 setae/spines .....  
..... *P. galapagoensis* Mielke, 1989

47. Exp3P3 with 5 setae/spines ..... 48  
Exp3P3 with 6 setae/spines ..... 51

48. A1 with unguiform process on second segment  
..... *P. parabradyi* Lang, 1965  
A1 without such process ..... 49

49. Abdominal somites with spiniform cuticular  
extensions ..... *P. alatus* Fiers, 1986  
Abdominal somites without such extensions 50

50. ExpP5 with 5 setae in male .....  
..... *P. thiebaudi thiebaudi* Petkovski, 1955  
ExpP5 with 4 setae in male .....  
..... *P. thiebaudi santacruzensis* Mielke, 1989

51. A1 with strong, sharp, unguiform process on  
second segment .....  
..... *P. setouchinensis* Kitazima, 1981  
A1 without or with small blunt process ..... 52

52. A1 without any process on second segment .....  
..... *P. gracilipes* Wells and Rao, 1987  
A1 with small blunt process ..... 53

53. Enp1P1 about as long as ExpP1 .....  
..... *P. briani briani* Petkovski, 1955  
Enp1P1 longer than ExpP1 .....  
..... *P. briani petkovskii* Kunz, 1984 stat. nov.

Large harpacticoid genera frequently accumulate  
numerous synonyms during the course of their  
taxonomic history. The genus *Phyllopodopsyllus* is  
especially rich with synonyms, many known of long  
standing. In such a way *P. pargos* Apostolov, 1969 is  
a synonym of *P. briani* Petkovski, 1955, what was  
noticed by Coull (1973) and accepted by Apostolov  
and Marinov (1988), although Kunz (1984) claimed  
it to be a synonym of *P. thiebaudi* Petkovski, 1955.  
Lang (1965) noticed that *P. intermedius* (Noodt,  
1955) is a synonym of *P. thiebaudi* Petkovski, 1955.  
Two species were synonymized by their authors  
themselves: Kunz (1963) synonymized his *P.*  
*trichophorus* (Kunz, 1951) with *P. mossmani* T. Scott,  
1912; and Apostolov (1972) synonymized his *P.*  
*ponticus* Apostolov, 1968 with *P. pauli* Crisafi, 1960.  
*P. mielkei mielkei* Kunz, 1984 and *P. mielkei*  
*californicus* Kunz (1984) are synonyms of *P.*  
*setouchiensis* Kitazima, 1981, which was nicely  
noticed by Mielke (1992), but also *P. crenulatus*  
Wells and Rao, 1987 is a synonym of *P. setouchiensis*.  
Although Wells and Rao (1987) said that *P.*  
*crenulatus* "is unique in no single character but the  
combination is not matched by any other species of

the genus", furcal rami shape, setal formula, antennulae, and many other characteristics are quite the same as in *P. setouchiensis*. *P. gertrudi* Kunz, 1984 and *P. gertrudi costaricensis* Mielke, 1992 are synonyms of *P. aegypticus* Nicholls, 1944. As a result of the description of *P. g. costaricensis*, Mielke (1992) unintentionally returned the nominal species *P. gertrudi* within the range of the species *P. aegypticus*, because the only traditionally used differentiating character (i.e. distal exopodite segment of third swimming leg with 5 or 6 elements) become invalid. Both species have, among other characters, quite the same extraordinary strong spines on the distal endopodite segments of second and third swimming legs (see Kunz, 1984; Wells and Rao, 1987; and Mielke, 1992). *P. yucatanensis* Fiers, 1995 is an obvious synonym of *P. parafurciger* Geddes, 1968, and it is very strange how Fiers (1995) tried to make differential diagnosis of his species on the base of the relative length of some setae. Several species are included in the key, because we could not claim with the great certainty that they are synonyms. Thus, the differential character (furcal length/width ratio) between *P. curtus* Marcus, 1976 and *P. stigmus* Wells and Rao, 1987 applied in our key should be used with caution since the variability of the first species is unknown. Although Marcus (1976) mentioned that the furcal index is 9, from the drawings that she provided it appears that the ratio is not higher than 6.4. *P. carinatus* Mielke, 1992 is very similar to *P. paraborutzkyi* Kunz, 1975, but the variability of the latter is practically unknown (Kunz, 1975). The same applies to *P. galapagoensis* Mielke, 1989 and *P. chavez* Coull, 1970 (see Mielke, 1989; Coull, 1970). *P. petkovskii* Kunz, 1984 is so similar to *P. briani* Petkovski, 1955 that, since their populations are located on two completely opposite parts of the world, the former can be at most considered as a subspecies of *P. briani*, and so has been treated in our key (as *P. briani petkovskii* Kunz, 1984 stat. nov.). Two species are not included in the key although they clearly belong to the genus *Phyllopodopsyllus*: *P. minor* (T. and A. Scott, 1903) and *P. tristanensis* (Wiborg, 1964). These two species are considered incertae sedis, because of the incompleteness of their descriptions. Lang (1965) and Coull (1973) included *P. minor* in their keys on the basis of the furcal rami shape, but today this is impossible.

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